

Supplementary material

Spatio-temporal variability of amphipod assemblages associated with rhodolith seabeds

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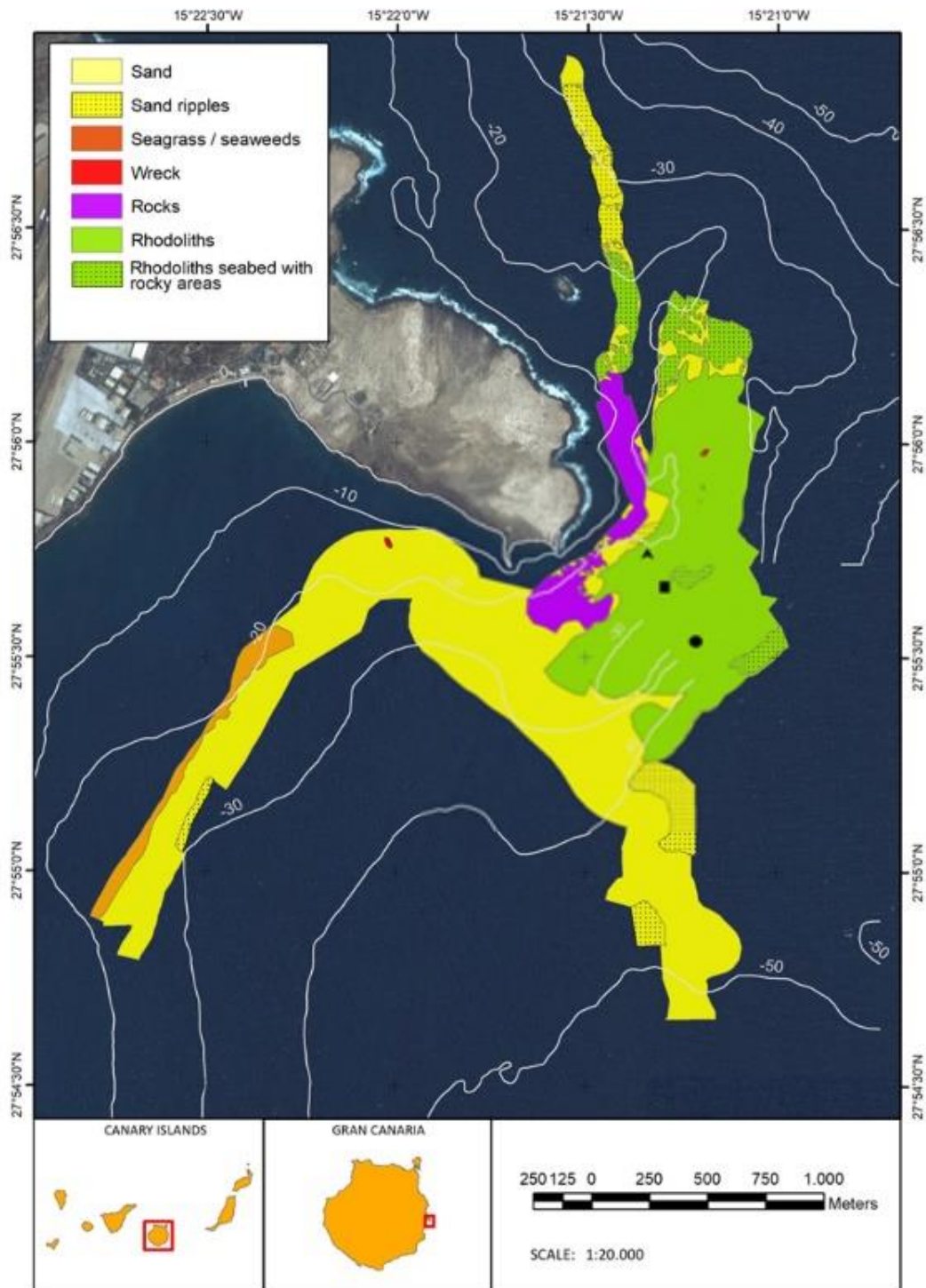


Fig. S1. Location of the study area at the island of Gran Canaria (northeast Atlantic Ocean), including the three sampling sites at 18 m (triangle), 25 m (square) and 40 m (circle) depth. The cartography was carried out from side scan sonar technologies.

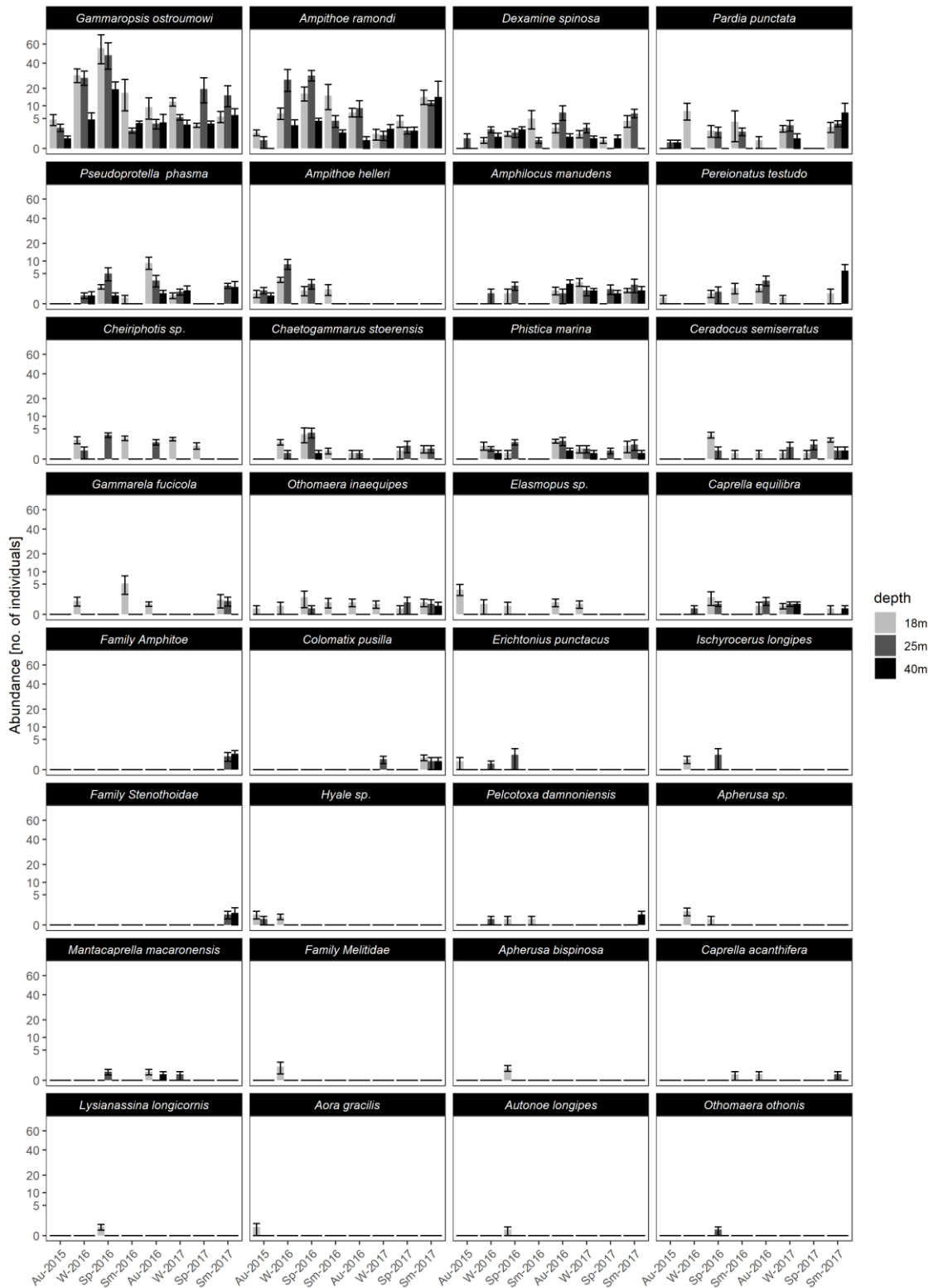


Fig. S2. Temporal variation in the abundance of amphipods (number of individuals, standardized per the amount of available habitat) at each depth stratum (18, 25 and 40 m) during two consecutive years (December 2015 to October 2017).

Table S1. Analysis of Deviance testing for the effects of ‘Depth’, ‘Year’ and ‘Season’ on the multivariate structure of amphipods, including Deviance values and associated *P*-values

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Res. df	d.f.	Dev	<i>P</i>
(Intercept)	119			
Covariable= Biomass algae	118	1	84.2	0.003**
Depth	116	2	223.3	0.002**
Year	115	1	124.0	0.001***
Season	112	3	334.3	0.001***
Depth × Year	110	2	101.3	0.001***
Depth × Season	104	6	215.4	0.001***
Year × Season	101	3	358.9	0.001***
Depth × Year × Season	95	8	698.9	0.001***

Table S2. Results of the multivariate GLM testing for the effects of ‘Depth’, ‘Year’ and ‘Season’ on the multivariate structure of amphipods, including associated *P*-values

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Wald value	<i>P</i>
(Intercept)	3.328	0.06594
Biomass algae	6.137	0.189810
Depth (25 m)	1.357	0.372627
Depth (40 m)	1.327	1.96803
Year	3.329	0.065934
Season (Spring)	6.927	0.000999***
Season (Winter)	4.556	0.001998**
Season (Summer)	3.388	0.035964*
Depth (25 m) × Year	1.357	0.372627
Depth (40 m) × Year	1.327	0.196803
Depth (25 m) × Season (Spring)	3.013	0.025974*
Depth (40 m) × Season (Spring)	0.125	0.961039
Depth (25 m) × Season (Winter)	2.092	0.114885
Depth (40 m) × Season (Winter)	0.583	0.585415
Depth (25 m) × Season (Summer)	3.739	0.002997**
Depth (40 m) × Season (Summer)	0.444	0.803197
Year × Season (Spring)	6.925	0.000999***
Year × Season (Winter)	4.555	0.001998**
Year × Season (Summer)	3.387	0.035964*
Depth (25 m) × Year × Season (Spring)	3.013	0.025974*
Depth (40 m) × Year × Season (Spring)	0.125	0.961039
Depth (25 m) × Year × Season (Winter)	2.091	0.114885
Depth (40 m) × Year × Season (Winter)	0.584	0.585415
Depth (25 m) × Year × Season (Summer)	3.739	0.002997**
Depth (40 m) × Year × Season (Summer)	0.443	0.804196

Table S3. Results of the mixed-effects GLM for the effect of ‘Depth’ and ‘Season’ on the epiphytic algal biomass

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	6.63943	0.42671	15.560	<2e-16***
Depth (25 m)	0.21135	0.60344	0.350	0.72615
Depth (40 m)	-2.31311	0.60444	-3.827	0.00013***
Season (Spring)	0.06014	0.60345	0.100	0.92062
Season (Winter)	-1.86098	0.60405	-3.081	0.00206**
Season (Summer)	0.15243	0.60344	0.253	0.80058
Depth (25 m) × Season (Spring)	-0.38473	0.85341	-0.451	0.65213
Depth (40 m) × Season (Spring)	0.91614	0.85433	1.072	0.28356
Depth (25 m) × Season (Winter)	-0.15094	0.85421	-0.177	0.85975
Depth (40 m) × Season (Winter)	1.87590	0.85522	2.193	0.02827*
Depth (25 m) × Season (Summer)	-0.53074	0.85341	-0.622	0.53400
Depth (40 m) × Season (Summer)	0.41172	0.85447	0.482	0.62992

Table S4. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the richness of amphipods

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	1.86828	0.15299	12.212	<2e-16***
Depth (25 m)	-0.34572	0.22565	-1.532	0.125500
Depth (40 m)	-0.95486	0.26302	-3.630	0.000283***
Season (Spring)	0.06697	0.20963	0.319	0.749380
Season (Winter)	0.14267	0.20619	0.692	0.488960
Season (Summer)	0.11767	0.20710	0.568	0.569908
Depth (25 m) × Season (Spring)	0.35923	0.30577	1.175	0.240058
Depth (40 m) × Season (Spring)	0.15096	0.36032	0.419	0.675240
Depth (25 m) × Season (Winter)	0.20632	0.30578	0.675	0.499850
Depth (40 m) × Season (Winter)	0.25016	0.35120	0.712	0.476280
Depth (25 m) × Season (Summer)	0.11332	0.30932	0.366	0.714115
Depth (40 m) × Season (Summer)	0.44615	0.34561	1.291	0.196744

Table S5. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the total abundance of amphipods

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	3.0670	0.4344	7.060	1.66e-12***
Depth (25 m)	-0.5174	0.3826	-1.353	0.716
Depth (40 m)	-1.7770	0.4096	-4.339	0.0000143***
Season (Spring)	0.2702	0.4146	0.652	0.515
Season (Winter)	0.1505	0.4210	0.358	0.721
Season (Summer)	0.3297	0.4256	0.775	0.438
Depth (25 m) × Season (Spring)	0.8282	0.5291	1.565	0.117
Depth (40 m) × Season (Spring)	0.7381	0.5533	1.334	0.182
Depth (25 m) × Season (Winter)	0.5308	0.5297	1.002	0.316
Depth (40 m) × Season (Winter)	0.4561	0.5590	0.816	0.415
Depth (25 m) × Season (Summer)	0.2860	0.5351	0.534	0.593
Depth (40 m) × Season (Summer)	1.3811	0.5560	2.484	0.013*

Table S6. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *G. ostroumowi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	1.7373	0.3699	4.697	2.64e-16***
Depth (25 m)	-0.8429	0.4349	-1.938	0.05258
Depth (40 m)	-1.2402	0.4501	-2.755	0.00587**
Season (Spring)	1.2276	0.4194	2.927	0.00342**
Season (Winter)	1.1013	0.4253	2.590	0.00961**
Season (Summer)	0.4649	0.4292	1.082	0.27875
Depth (25 m) × Season (Spring)	1.1996	0.5803	2.067	0.03870*
Depth (40 m) × Season (Spring)	0.4007	0.5953	0.673	0.50092
Depth (25 m) × Season (Winter)	0.5082	0.5821	0.873	0.38270
Depth (40 m) × Season (Winter)	-0.3544	0.6110	-0.580	0.56187
Depth (25 m) × Season (Summer)	0.9939	0.5981	1.662	0.09656
Depth (40 m) × Season (Summer)	0.6455	0.6139	1.051	0.29306

Table S7. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *A. ramondi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	1.1675	0.6067	1.924	0.054327
Depth (25 m)	-0.1759	0.5393	-0.326	0.744328
Depth (40 m)	-3.1676	0.9024	-3.510	0.000448***
Season (Spring)	0.5169	0.5716	0.904	0.365798
Season (Winter)	-0.4639	0.5843	-0.794	0.427165
Season (Summer)	1.1093	0.5851	1.896	0.057950
Depth (25 m) × Season (Spring)	0.4365	0.7169	0.609	0.542642
Depth (40 m) × Season (Spring)	2.0054	1.0327	1.942	0.052153
Depth (25 m) × Season (Winter)	1.2615	0.7287	1.731	0.083427
Depth (40 m) × Season (Winter)	2.9177	1.0454	2.791	0.005257**
Depth (25 m) × Season (Summer)	-0.3262	0.7196	-0.453	0.650346
Depth (40 m) × Season (Summer)	2.7979	1.0220	2.738	0.006187**

Table S8. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *D. spinosa*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	0.1823	0.4318	0.422	0.6729
Depth (25 m)	1.1718	0.5615	2.099	0.0358*
Depth (40 m)	-1.0986	0.7346	-1.496	0.1348
Season (Spring)	-0.4055	0.6439	-0.630	0.5289
Season (Winter)	-0.4055	0.6349	-0.630	0.5289
Season (Summer)	1.3437	0.5580	2.408	0.0160*
Depth (25 m) × Season (Spring)	-1.3122	0.8885	-1.477	0.1397
Depth (40 m) × Season (Spring)	1.5841	0.9736	1.627	0.1037
Depth (25 m) × Season (Winter)	-0.1671	0.8319	-0.201	0.8408
Depth (40 m) × Season (Winter)	0.9651	1.0069	0.958	0.3378
Depth (25 m) × Season (Summer)	-1.4238	0.7557	-1.884	0.0596.
Depth (40 m) × Season (Summer)	-19.7300	298.9581	-0.007	0.9947

Table S9. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *P. punctata*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	-1.6094	0.8257	-1.888	0.05909
Depth (25 m)	-0.6931	1.3979	-0.496	0.62000
Depth (40 m)	-0.6931	1.3979	-0.496	0.62000
Season (Spring)	1.5041	1.0321	1.547	0.14503
Season (Winter)	3.2189	0.9870	3.261	0.00111**
Season (Summer)	2.8034	0.9922	2.825	0.00472**
Depth (25 m) × Season (Spring)	0.5754	1.6261	0.354	0.72347
Depth (40 m) × Season (Spring)	-18.5041	298.9584	-0.006	0.99505
Depth (25 m) × Season (Winter)	-0.5108	1.5795	-0.323	0.74639
Depth (40 m) × Season (Winter)	-2.1203	1.6618	-1.276	0.20200
Depth (25 m) × Season (Summer)	0.4155	1.5743	0.264	0.79183
Depth (40 m) × Season (Summer)	0.7802	1.5705	0.497	0.61935

Table S10. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *P. phasma*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	1.5261	0.5146	2.966	0.00302**
Depth (25 m)	-1.1206	0.7580	-1.478	0.13931
Depth (40 m)	-2.7300	0.9172	-2.977	0.00292**
Season (Spring)	-1.7492	0.7955	-2.199	0.02790*
Season (Winter)	-3.1355	1.0039	-3.123	0.00179**
Season (Summer)	-3.8286	1.2280	-3.118	0.00182**
Depth (25 m) × Season (Spring)	2.2600	1.1071	2.041	0.04121**
Depth (40 m) × Season (Spring)	1.1347	1.3973	0.962	0.33621
Depth (25 m) × Season (Winter)	2.2192	1.3143	1.689	0.09131
Depth (40 m) × Season (Winter)	3.9828	1.4036	2.837	0.00455**
Depth (25 m) × Season (Summer)	3.3178	1.4737	2.251	0.02436*
Depth (40 m) × Season (Summer)	4.8095	1.5660	3.071	0.00213**

Table S11. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of *A. helleri*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	-1.2040	0.7935	-1.517	0.1292
Depth (25 m)	0.5108	1.0612	0.481	0.6302
Depth (40 m)	-0.4055	1.1942	-0.340	0.7342
Season (Spring)	0.5108	1.0612	0.481	0.6302
Season (Winter)	1.6740	0.9943	1.684	0.0923
Season (Summer)	0.6931	1.0454	0.663	0.5073
Depth (25 m) × Season (Spring)	0.2776	1.4177	0.196	0.8447
Depth (40 m) × Season (Spring)	-20.2040	8103.0841	-0.002	0.9980
Depth (25 m) × Season (Winter)	0.4778	1.3434	0.356	0.7221
Depth (40 m) × Season (Winter)	-21.3671	8103.0840	-0.003	0.9979
Depth (25 m) × Season (Summer)	-21.3026	8103.0840	-0.003	0.9979
Depth (40 m) × Season (Summer)	-20.3863	8103.0841	-0.003	0.9980

Table S12. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of juveniles of *G. ostroumowi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z value	P
(Intercept)	-0.5108	0.4893	-1.044	0.296525
Depth (25 m)	-2.3863	1.4476	-1.129	0.896786
Depth (40 m)	-19.7918	4914.7689	-0.004	0.00000001***
Season (Spring)	2.7408	0.5683	4.823	0.0000142***
Season (Winter)	2.1203	0.5764	3.678	0.000235***
Season (Summer)	0.1542	0.6746	0.229	0.819254
Depth (25 m) × Season (Spring)	19.6030	4914.7684	0.004	0.996818
Depth (40 m) × Season (Spring)	-2.7408	6950.5328	0.000	0.999685
Depth (25 m) × Season (Winter)	18.6523	4914.7688	0.004	0.996972
Depth (40 m) × Season (Winter)	-2.1202	6950.5328	0.001	0.999757
Depth (25 m) × Season (Summer)	20.3308	4914.7688	0.004	0.996699
Depth (40 m) × Season (Summer)	-0.1542	6950.5328	0.000	0.999982

Table S13. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of ovigerous females of *G. ostroumowi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z value	P
(Intercept)	-0.5108	7.327	-2.196	0.028056*
Depth (25 m)	0.1542	1.036	0.000	1.000000
Depth (40 m)	-19.7918	2.981	-0.006	0.0000001***
Season (Spring)	2.7408	8.605	1.277	0.201700
Season (Winter)	2.1203	7.742	3.837	0.000125***
Season (Summer)	0.1542	1.036	0.000	1.000000
Depth (25 m) × Season (Spring)	19.6030	1.102	0.464	0.642951
Depth (40 m) × Season (Spring)	-2.7408	2.981	0.005	0.995744
Depth (25 m) × Season (Winter)	18.6523	1.034	-1.254	0.209887
Depth (40 m) × Season (Winter)	-2.1202	2.981	0.005	0.995951
Depth (25 m) × Season (Summer)	20.3308	1.575	-0.697	0.485494
Depth (40 m) × Season (Summer)	-0.1542	2.981	0.006	0.995450

Table S14. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of juveniles of *A. ramondi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	-0.9163	0.7300	-1.255	0.2094
Depth (25 m)	-1.3863	1.3475	-1.029	0.3036
Depth (40 m)	-19.3863	4914.7689	-0.004	0.000001***
Season (Spring)	1.8718	0.9243	2.025	0.0428*
Season (Winter)	0.4055	0.9912	0.409	0.6825
Season (Summer)	1.0986	0.9482	1.159	0.2466
Depth (25 m) × Season (Spring)	1.8418	1.5635	1.178	0.2388
Depth (40 m) × Season (Spring)	-1.8718	6950.5328	0.000	0.9998
Depth (25 m) × Season (Winter)	1.3863	1.6477	0.841	0.4002
Depth (40 m) × Season (Winter)	-0.4055	6950.5329	0.000	1.0000
Depth (25 m) × Season (Summer)	-1.0986	1.8614	-0.590	0.5551
Depth (40 m) × Season (Summer)	18.9808	4914.7690	0.004	0.9969

Table S15. Results of the mixed-effects GLM testing for the effects of ‘Depth’ and ‘Season’ on the abundance of ovigerous females of *A. ramondi*

Significant differences at *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.0001$

	Estimate	s.e.	Z-value	P
(Intercept)	-19.30	2981	-0.006	0.995
Depth (25 m)	18.39	2981	0.006	0.995
Depth (40 m)	-2.069*10 ⁻⁸	4216	0.000	1.000
Season (Spring)	19.40	2981	0.007	0.995
Season (Winter)	19.08	2981	0.006	0.995
Season (Summer)	19.20	2981	0.006	0.995
Depth (25 m) × Season (Spring)	-17.61	2981	-0.006	0.995
Depth (40 m) × Season (Spring)	-1.299	4216	0.000	1.000
Depth (25 m) × Season (Winter)	-18.07	2981	-0.006	0.995
Depth (40 m) × Season (Winter)	-0.9808	4216	0.000	1.000
Depth (25 m) × Season (Summer)	-19.89	2981	-0.007	0.995
Depth (40 m) × Season (Summer)	-0.5878	4216	0.000	1.000